In re Gao et al.

Filed: October 29, 2001

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#### REMARKS

Applicants note that the Restriction Requirement indicates that Claims 1-97 are pending in the application and that the PAIR File Contents History for this application does not indicate receipt of a Preliminary Amendment and an Information Disclosure Statement that were mailed to the USPTO on March 1, 2002 via First Class Mail. A copy of the Preliminary Amendment and Information Disclosure Statement are included herewith. Applicants' election of species in response to the Restriction Requirement is made with the assumption that the amendments proposed in the Preliminary Amendment have been entered. If those amendments have not been entered, Applicants respectfully request that the Examiner enter those amendments prior to the consideration of the response to the Restriction Requirement.

Claims 2-97 are pending in the application, Claim 1 having been cancelled by the Preliminary Amendment dated March 1, 2002. Claims 2, 6, 11, 19, 21, 37, 43, 46, 54, 62, 64, 72, 73, 76, 86, 93, and 95 are amended herein. Claims 23-30, 44, 54, 65, 66, 70, 71, 74, 88, and 89 are withdrawn. Applicants also add Claim 98 to the present application.

The Restriction Requirement dated October 1, 2003 requires the Applicants to elect a single disclosed species for prosecution under 35 U.S.C. § 121 and indicates that Claims 1, 37, and 95 are generic. The species for election are defined as follows:

For transition metal (M<sup>1</sup>) of the active material: Ti; V; Cr or Mo; Mn; and Fe, Ni or Co. For the dopant metal of the active material: Li; Mg, Ca, Sr, or Ba; Te; Ti or Zr; Mo; and Co or Ru.

For the metal of the ionically conductive lithium oxide: Al; Sn, Si or Ge; Te; Ti, Hf or Zr; Mo; Mn; Ru.

Applicants hereby elect the following species:

For the transition metal M<sup>1</sup>: Fe, Ni, and Co;

For the dopant metal: Ti and/or Zr; and

For the metal of the ionically conductive lithium oxide M<sup>2</sup>: Ti, Hf, and Zr.

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Claims 2-22, 31-43, 45-53, 54-64, 67-69, 72, 73, 75-87, and 90-98 generally read on the elected species. Claims 23-30, 44, 54, 65, 66, 70, 71, 74, 88, and 89 are withdrawn as reading on non-elected species with the understanding that the withdrawn claims will be entitled to consideration upon the allowance of any generic Claims, including Claims 1, 37, and 95.

Applicant respectfully submits that this application is now in condition for substantive examination, which action is requested. If any extension of time for the accompanying response or submission is required, Applicant requests that this be considered a petition therefor. The Commissioner is hereby authorized to charge any additional fee, which may be required, or credit any refund, to our Deposit Account No. 50-0220. Any questions that the Examiner may have about the foregoing may be directed to the undersigned, who can be reached at 919-854-1400.

Respectfully submitted,

Devin R. Jensen

Registration No. 44,805

Myers Bigel Sibley & Sajovec, P.A.

P. O. Box 37428

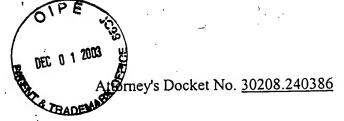
Raleigh, North Carolina 27627 Telephone: (919) 854-1400 Facsimile: (919) 854-1401 Customer Number 20792

CERTIFICATE OF EXPRESS MAILING

"Express Mail" mailing label number: EV318417988US Date of Deposit: December 1, 2003

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Sloan Smith



RADEMARK OFFICE IN THE UNITED STA

In re:

Gao et al.

Appl. No.: 10/040,047

Filed: For:

October 29, 2001

POSITIVE ELECTRODE ACTIVE MATERIALS FOR SECONDARY

BATTERIES AND METHODS OF PREPARING SAME

March 1, 2002

Confirmation No.: 1829

Group Art Unit: 1741

PROCEIVED TO 1700

Commissioner for Patents Washington, DC 20231

## PRELIMINARY AMENDMENT

Sir:

Please amend the above-identified application as follows:

### In the Claims:

Please cancel Claim 1, without prejudice.

(Rewritten) A positive electrode active material for secondary lithium and 2. lithium-ion batteries comprising:

at least one electron conducting compound having the formula LiM1x-y{A}yOz wherein  $M^1$  is a transition metal;  $\{A\}$  is represented by the formula  $\sum w_i B_i$  wherein  $B_i$  is an element other than M<sup>1</sup> used to replace the transition metal M<sup>1</sup> and w<sub>i</sub> is the fractional amount of element B<sub>i</sub> in the total dopant combination such that  $\sum w_i = 1$ ;  $B_i$  is a cation in  $LiM^1_{x-y}\{A\}_yO_z$ ;  $0.95 \le x \le 1.05$ ;  $0 \le y \le x/2$ ; and  $1.90 \le z \le 2.10$ ; and

at least one electron insulating and lithium ion conducting lithium metal oxide selected from the group consisting of LiAlO2 and Li2M2O3, wherein M2 is at least one tetravalent metal selected from the group consisting of Ti, Zr, Mn, Mo, Si, Ge, Hf, Ru and Te.

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- (Amended) The positive electrode active material according to Claim 2, 5. comprising from greater than or equal to 95% by weight and less than 100% by weight of  $LiM^{1}_{x-y}{A}_{y}O_{z}$  and greater than 0% by weight and less than or equal to 5% by weight of the lithium metal oxide.
- (Amended) The positive electrode active material according to Claim 2, wherein 6. M<sup>1</sup> is selected from the group consisting of Co, Ni, Mn and Ti.
- (Amended) The positive electrode active material according to Claim 2, wherein 7. x=1 and z=2.
- (Amended) The positive electrode active material according to Claim 2, wherein 10. y > 0.
- (Amended) The positive electrode active material according to Claim 2, wherein 18. x, y and z are values that provide a stable lithium metal oxide compound.
- (Amended) The positive electrode active material according to Claim 2, wherein 25. the LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> compound has the formula LiNi<sub>1-y</sub>CO<sub>2</sub>M<sup>3</sup><sub>b</sub>M<sup>4</sup><sub>c</sub>O<sub>2</sub>, wherein M<sup>3</sup> is selected from the group consisting of Ti, Zr, and combinations thereof; M<sup>4</sup> is selected from the group consisting of Mg, Ca, Sr, Ba, and combinations thereof; y=a+b+c,  $0 < y \le 0.5$ ; 0 < a < 0.5; 0 < b < 0.15; and  $0 < c \le 0.15$ .
- (Amended) The positive electrode active material according to Claim 2, further 31. comprising at least one electron insulating and lithium-ion conducting metal oxide.
- (Amended) The positive electrode active material according to Claim 31, wherein 32. the metal oxide has the formula MO2 wherein M is at least one tetravalent metal selected from the group consisting of Ti, Zr, Mo, Si, Ge, Hf, Ru and Te.

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- (Amended) A positive electrode for a secondary lithium or lithium-ion battery 35. comprising the positive electrode active material of Claim 2, a carbonaceous material and a polymer binder.
- (Amended) A secondary lithium or lithium-ion battery comprising a positive 36. electrode, a negative electrode and a nonaqueous electrolyte, wherein the positive electrode includes the positive electrode active material of Claim 2.
- (Amended) A positive electrode active material for secondary lithium and lithium-37. ion batteries comprising at least one compound of the formula LiM1x-y{A}yOz and at least one lithium metal oxide selected from the group consisting of LiAlO2 and Li2M2O3, wherein M1 is a transition metal, M2 is at least one tetravalent metal selected from the group consisting of Ti, Zr, Mn, Mo, Si, Ge, Hf, Ru and Te,  $\{A\}$  is represented by the formula  $\sum w_i B_i$  wherein  $B_i$  is an element other than M<sup>1</sup> used to replace the transition metal M<sup>1</sup> and w<sub>i</sub> is the fractional amount of element  $B_i$  in the total dopant combination such that  $\sum w_i = 1$ ;  $B_i$  is a cation in  $LiM^i_{x-y}\{A\}_yO_z$ ;  $0.95 \le x \le 2.10$ ;  $0 \le y \le x/2$ ; and  $1.90 \le z \le 4.20$ .
- (Amended) The positive electrode active material according to Claim 56, wherein 57. the metal oxide has the formula MO2 wherein M is at least one tetravalent metal selected from the group consisting of Ti, Zr, Mo, Si, Ge, Hf, Ru and Te.
- (Amended) A method of preparing a positive electrode active material for 62. secondary lithium and lithium-ion batteries, the positive electrode active material including separate lithium metal oxide phases corresponding to the formulas LiM1x-y{A}yOz and Li2M2O3 or LiAlO<sub>2</sub>, comprising the steps of:

intimately mixing source compounds containing M1, Li and optionally {A} in amounts sufficient to provide a stoichiometric relationship between M1, Li and {A} corresponding to the formula  $LiM^{1}_{x-y}\{A\}_{y}O_{z}$  wherein  $M^{1}$  is a transition metal,  $\{A\}$  is represented by the formula

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 $\sum w_i B_i$  wherein  $B_i$  is an element other than  $M^1$  used to replace the transition metal  $M^1$  and  $w_i$  is the fractional amount of element  $B_i$  in the total dopant combination such that  $\sum w_i = 1$ ;  $B_i$  is a cation in  $LiM^1_{x-y}\{A\}_yO_z$ ; at least one of  $M^1$  and  $B_i$  is selected from the group consisting of Ti, Zr, Mn, Mo, Si, Al, Ge, Hf, Ru and Te;  $0.95 \le x \le 2.10$ ;  $0 \le y \le x/2$ ; and  $1.90 \le z \le 4.20$ ;

firing the mixture in the presence of oxygen at an initial firing temperature and optionally one or more additional firing temperatures, at least one of said initial firing temperature and optionally one or more additional firing temperatures being the maximum firing temperature and at least one of said initial firing temperature and optionally one or more additional firing temperatures being between about 700°C and about 1000°C, wherein said firing step comprises heating the mixture at a sufficiently slow rate from 500°C to the maximum firing temperature to produce separate lithium metal oxide phases including LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> and LiAlO<sub>2</sub> or Li<sub>2</sub>M<sup>2</sup>O<sub>3</sub>, wherein M<sup>2</sup> is one of M<sup>1</sup> and B<sub>i</sub>, and M<sup>2</sup> is selected from the group consisting of Ti, Zr, Mn, Mo, Si, Ge, Hf, Ru and Te; and

cooling the LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> and Li<sub>2</sub>M<sup>2</sup>O<sub>3</sub> or LiAlO<sub>2</sub> compounds.

- (Amended) The method according to Claim 62, wherein said firing step comprises 64. heating the mixture at a sufficiently slow rate from 500°C to the maximum firing temperature to produce separate lithium metal oxide phases including LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub>, Li<sub>2</sub>M<sup>2</sup>O<sub>3</sub> and M<sup>2</sup>O<sub>2</sub>, wherein one of M<sup>1</sup> and B<sub>i</sub> is M<sup>2</sup> and M<sup>2</sup> is selected from the group consisting of Ti, Zr, Mo, Si, Ge, Hf, Ru and Te.
- (Amended) The method according to Claim 62, wherein one of M<sup>1</sup> and B<sub>i</sub> is 70. selected from the group consisting of Ti, Zr, Mn, Mo, Si, Ge, Hf, Ru and Te.

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#### REMARKS

Applicants have amended Claims 2, 5-7, 10, 18, 25, 31-32, 35-37, 57, 62, 64 and 70 and cancelled Claim 1 as shown herein. Applicants respectfully submit that the claim amendments are supported by the specification and request entry of same.

Applicants respectfully submit that all the claims are in condition for allowance. Accordingly, a Notice of Allowance is respectfully requested in due course. If any minor informalities need to be addressed, the Examiner is directed to contact the undersigned attorney by telephone to facilitate prosecution of this case.

Respectfully submitted,

Andrew T. Meunier Registration No. 40,726

Customer No. 00826 ALSTON & BIRD LLP

Bank of America Plaza 101 South Tryon Street, Suite 4000 Charlotte, NC 28280-4000 Tel Atlanta Office (404) 881-7000 Fax Atlanta Office (404) 881-7777

### CERTIFICATE OF MAILING

I hereby certify that this paper or fee is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, Washington, DC 20231 on March 1, 2002.

Barbara Yates

Gao et al.

Appl. No.: 10/040,047

Filed:

October 29, 2001

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# Version with Markings to Show Changes Made:

### In the Claims:

Please cancel Claim 1, without prejudice.

(Rewritten) A [The] positive electrode active material [according to Claim 1,] for 2. secondary lithium and lithium-ion batteries comprising:

at least one electron conducting compound having the formula LiM1x-y{A}yOz wherein  $M^{1}$  is a transition metal;  $\{A\}$  is represented by the formula  $\sum w_{i}B_{i}$  wherein  $B_{i}$  is an element other than M<sup>1</sup> used to replace the transition metal M<sup>1</sup> and w<sub>i</sub> is the fractional amount of element B<sub>i</sub> in the total dopant combination such that  $\sum w_i = 1$ ;  $B_i$  is a cation in  $LiM^1_{x-y}\{A\}_yO_z$ ;  $0.95 \le x \le 1.05$ ;  $0 \le y \le x/2$ ; and  $1.90 \le z \le 2.10$ ; and

at least one electron insulating and lithium ion conducting lithium metal oxide [wherein the lithium metal oxide is] selected from the group consisting of LiAlO2 and Li2M2O3, wherein M<sup>2</sup> is at least one tetravalent metal selected from the group consisting of Ti, Zr, [Sn,] Mn, Mo, Si, Ge, Hf, Ru and Te.

- (Amended) The positive electrode active material according to Claim [1] 2, 5. comprising from greater than or equal to 95% by weight and less than 100% by weight of LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> and greater than 0% by weight and less than or equal to 5% by weight of the lithium metal oxide.
- (Amended) The positive electrode active material according to Claim [1] 2, 6. wherein M<sup>1</sup> is selected from the group consisting of Co, Ni, Mn and Ti.
- (Amended) The positive electrode active material according to Claim [1] 2, 7. wherein x=1 and z=2.
  - (Amended) The positive electrode active material according to Claim [1] 2, 10.

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wherein y > 0.

- 18. (Amended) The positive electrode active material according to Claim [1] 2, wherein x, y and z are values that provide a stable lithium metal oxide compound.
- 25. (Amended) The positive electrode active material according to Claim [1]  $\underline{2}$ , wherein the LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> compound has the formula LiNi<sub>1-y</sub>Co<sub>a</sub>M<sup>3</sup><sub>b</sub>M<sup>4</sup><sub>c</sub>O<sub>2</sub>, wherein M<sup>3</sup> is selected from the group consisting of Ti, Zr, and combinations thereof; M<sup>4</sup> is selected from the group consisting of Mg, Ca, Sr, Ba, and combinations thereof; y=a+b+c,  $0 < y \le 0.5$ ; 0 < a < 0.5;  $0 < b \le 0.15$ ; and  $0 < c \le 0.15$ .
- 31. (Amended) The positive electrode active material according to Claim [1] 2, further comprising at least one electron insulating and lithium-ion conducting metal oxide.
- 32. (Amended) The positive electrode active material according to Claim 31, wherein the metal oxide has the formula MO<sub>2</sub> wherein M is at least one tetravalent metal selected from the group consisting of Ti, Zr, [Sn,] Mo, Si, Ge, Hf, Ru and Te.
- 35. (Amended) A positive electrode for a secondary lithium or lithium-ion battery comprising the positive electrode active material of Claim [1] 2, a carbonaceous material and a polymer binder.
- 36. (Amended) A secondary lithium or lithium-ion battery comprising a positive electrode, a negative electrode and a nonaqueous electrolyte, wherein the positive electrode includes the positive electrode active material of Claim [1] 2.
- 37. (Amended) A positive electrode active material for secondary lithium and lithium-ion batteries comprising at least one compound of the formula LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> and at least one lithium metal oxide selected from the group consisting of LiAlO<sub>2</sub> and Li<sub>2</sub>M<sup>2</sup>O<sub>3</sub>, wherein M<sup>1</sup> is a

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Filed:

October 29, 2001

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transition metal, M<sup>2</sup> is at least one tetravalent metal selected from the group consisting of Ti, Zr, [Sn,] Mn, Mo, Si, Ge, Hf, Ru and Te,  $\{A\}$  is represented by the formula  $\Sigma w_i B_i$  wherein  $B_i$  is an element other than M<sup>1</sup> used to replace the transition metal M<sup>1</sup> and w<sub>i</sub> is the fractional amount of element  $B_i$  in the total dopant combination such that  $\sum w_i = 1$ ;  $B_i$  is a cation in  $LiM^1_{x-y}\{A\}_yO_z$ ;  $0.95 \le x \le 2.10$ ;  $0 \le y \le x/2$ ; and  $1.90 \le z \le 4.20$ .

- (Amended) The positive electrode active material according to Claim 56, wherein 57. the metal oxide has the formula MO<sub>2</sub> wherein M is at least one tetravalent metal selected from the group consisting of Ti, Zr, [Sn,] Mo, Si, Ge, Hf, Ru and Te.
- (Amended) A method of preparing a positive electrode active material for 62. secondary lithium and lithium-ion batteries, the positive electrode active material including separate lithium metal oxide phases corresponding to the formulas  $\text{LiM}^1_{x-y}\{A\}_yO_z$  and  $\text{Li}_2M^2O_3$ or LiAlO<sub>2</sub>, comprising the steps of:

intimately mixing source compounds containing M1, Li and optionally {A} in amounts sufficient to provide a stoichiometric relationship between M<sup>1</sup>, Li and {A} corresponding to the formula  $LiM^{1}_{x-y}\{A\}_{y}O_{z}$  wherein  $M^{1}$  is a transition metal,  $\{A\}$  is represented by the formula  $\sum w_i B_i$  wherein  $B_i$  is an element other than  $M^1$  used to replace the transition metal  $M^1$  and  $w_i$  is the fractional amount of element  $B_i$  in the total dopant combination such that  $\sum w_i = 1$ ;  $B_i$  is a cation in LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub>, at least one of M<sup>1</sup> and B<sub>i</sub> is selected from the group consisting of Ti, Zr, [Sn,] Mn, Mo, Si, Al, Ge, Hf, Ru and Te;  $0.95 \le x \le 2.10$ ;  $0 \le y \le x/2$ ; and  $1.90 \le z \le 4.20$ ;

firing the mixture in the presence of oxygen at an initial firing temperature and optionally one or more additional firing temperatures, at least one of said initial firing temperature and optionally one or more additional firing temperatures being the maximum firing temperature and at least one of said initial firing temperature and optionally one or more additional firing temperatures being between about 700°C and about 1000°C, wherein said firing step comprises heating the mixture at a sufficiently slow rate from 500°C to the maximum firing temperature to produce separate lithium metal oxide phases including LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> and LiAlO<sub>2</sub> or Li<sub>2</sub>M<sup>2</sup>O<sub>3</sub>, wherein M2 is one of M1 and Bi, and M2 is selected from the group consisting of Ti, Zr, [Sn,]

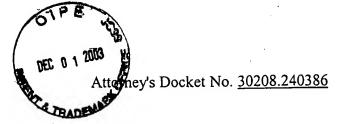
In re: Gao et al. Appl. No.: 10/040,047

Filed: October 29, 2001

Page 9 of 9

Mn, Mo, Si, Ge, Hf, Ru and Te; and cooling the LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub> and Li<sub>2</sub>M<sup>2</sup>O<sub>3</sub> or LiAlO<sub>2</sub> compounds.

- 64. (Amended) The method according to Claim 62, wherein said firing step comprises heating the mixture at a sufficiently slow rate from 500°C to the maximum firing temperature to produce separate lithium metal oxide phases including LiM<sup>1</sup><sub>x-y</sub>{A}<sub>y</sub>O<sub>z</sub>, Li<sub>2</sub>M<sup>2</sup>O<sub>3</sub> and M<sup>2</sup>O<sub>2</sub>, wherein one of M<sup>1</sup> and B<sub>i</sub> is M<sup>2</sup> and M<sup>2</sup> is selected from the group consisting of Ti, Zr, [Sn,] Mo, Si, Ge, Hf, Ru and Te.
- 70. (Amended) The method according to Claim 62, wherein one of M<sup>1</sup> and B<sub>i</sub> is selected from the group consisting of Ti, Zr, [Sn,] Mn, Mo, Si, Ge, Hf, Ru and Te.



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:

For:

Gao et al.

Appl. No.:

10/040,047

Filed:

October 29, 20021

Group Art Unit: 1741

Confirmation No.: 1829

POSITIVE ELECTRODE ACTIVE MATERIALS FOR SECONDA

BATTERIES AND METHODS OF PREPARING SAME

March 1, 2002

Commissioner for Patents Washington, DC 20231

# INFORMATION DISCLOSURE STATEMENT CITATION UNDER 37 C.F.R. § 1.97

Sir:

disclosure.

Attached is a list of documents on form PTO-1449 together with a copy of each identified document. It is requested that the Examiner consider these documents and officially make them of record in accordance with the provisions of 37 C.F.R. § 1.97 and Section 609 of the MPEP. By submitting the listed documents, Applicant in no way makes any admission as to the prior art status of the listed documents, but is instead submitting the listed documents for the sake of full

Respectfully submitted,

Andrew T. Meunier Registration No. 40,726

Customer No. 00826 ALSTON & BIRD LLP

Bank of America Plaza 101 South Tryon Street, Suite 4000 Charlotte, NC 28280-4000

Tel Atlanta Office (404) 881-7000

Fax Atlanta Office (404) 881-7777

### CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner For Patents, Washington, DC 20231, on March 1, 2002.

Barbara Yates

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STATEMENT BY APPLICANT					Gao et al.	CA
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<sup>\*</sup>Examiner: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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Gao et al.

Serial No.:

10/040,047

Filed:

February 1, 2002

Page 2

	A check in the amount of the fee is enclosed.
	Payment by credit card (Form PTO-2038) is enclosed.
$\boxtimes$	Charge Deposit Account No. 50-0220 for any additional extension and/or fee required or credit for any excess fee paid.

Respectfully submitted,

Devin R. Jensen

Registration No. 44,805

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